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Analysis of Representation Forms on Linear Equations System Two Variables (LESTV) Materials for Class VIII Junior High School

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Abstract: This qualitative research aims to find out the representation forms of material Linear Equations System Two Variables. Data collection methods are interviews and written tests. The subjects of this study were two class VIIIA students as representatives chosen based on two large groups of the same answer. The results showed that from the two groups had different forms of representation, the subjects of one group used visual representation, while the other group used symbolic representation.

Keywords: representation, linear equations system two variables, visual, symbolic

Introduction

Representation is very important for planning, monitoring, and controlling the process of solving mathematical problems. The forms of representation of each person are different, in solving a mathematical problem related to daily life, students use several methods that have been previously known. One way that students can solve a contextual problem is to make a mathematical model or mathematical representation of the problem. The type of mathematical representation that can be chosen depends on the ability of each individual to interpret the problem. Kilpatrick (in Minarni, Napitupulu, & Husein, 2016), states that representation can be used to understand mathematics. Mathematics requires representation because of the abstract nature of mathematics so that people have access to Mathematical ideas only through the representation of ideas. Representation is a configuration of one's thinking as a whole or divided which connects one another simultaneously (Goldin, & Kaput, 2013). For example, a graph of the function $f(x) = x^2$ is a representation of functions in the form of formulas, but the function can also be represented in several forms, such as graphs of functions and in the form of a cartesius diagram. Images, graphics, mathematical statements and written texts or combinations are all a variety of representations that are often used in communicating mathematics (Cai, Lane, & Jakabcsin, 1996). Furthermore, National Council of Teachers of Mathematics (NCTM) said that the purpose of students learning mathematics is to develop and deepen understanding of concepts and relationships of mathematics when they make, compare and use various representations (NCTM, 2000). People develop representations to interpret and remember their experiences in an effort to understand the world (Minarni, Napitupulu, & Husein, 2016).

The use of representation develops and deepens students' understanding of mathematical concepts. Representation allows students to make connections between concepts and communicate their thoughts through representation (Helingo, Mamin, & Masriyah, 2018). In recent years the mathematics education community has increasingly shown that representation is a useful tool for communicating information and understanding (NCTM, 2000). Some studies related to mathematical representation are (Nie & Cao, 2019; Sedig & Sumner, 2006; Rahmah, Subanji, & Irawati, 2019).

One solution to find out the forms of mathematical representation of students is through Realistic Mathematics Education (RME). The learning process begins by proposing contextual problems that are appropriate to everyday life or the experience and level of knowledge of students is one of the characteristics of RME. Through RME, students are expected to be able to develop mathematical representation skills because through the material given and accompanied by the provision of mathematical examples derived from the conditions of everyday life of students, can represent the questions better and simpler. RME based devices containing visual representation, verbal representation and symbol representation were developed to facilitate various student learning styles (Muhtarom, Nizaruddin, Nursyahidah, & Happy, 2019). This representation begins with realistic situations that are

close to students so that they can develop other representations. RME-based devices are expected to contribute positively to students in gaining mathematical understanding, increasing learning interactions, and developing multi-representation capabilities.

The purpose of this study is to find out the forms of representation that students use in solving problems related to LESTV.

Research Method

The Directorate General of Primary and Secondary Education of the Ministry of National Education The type of research conducted in this study is design research. This study aims to determine the ability of students' mathematical representation after applying the Realistic Mathematics Education approach. The subjects in this study were VIIIA grade students of SMP St. Aloysius Turi Yogyakarta 2018/2019 academic year consisting of 20 students then work or written test results from 20 students consisting of two large groups, namely seven students solve problems using image representation and 13 students solve problems using symbol representation, from each group one student was selected for analysis. At the reduction stage, the researcher summarizes the results of the test results of mathematical representation abilities which are then coded from the name of the student to facilitate writing on the data presentation namely student one (s1) with the code “RPH” and student two (s2) with the code “ARC”. This grouping is done to find out the achievement of students' mathematical representation ability based on indicators. The data analysis technique carried out in this study consisted of three stages, namely data reduction, presenting data, and drawing conclusions.

Indicators of students’ mathematical representation through RME are assessed based on criteria (Sulastri, Marwan, & Duskri, 2017).

- Presenting data or information from a problem to representation of images, diagrams, table graphs or symbols.
- Resolve problems that involve mathematically.
- Write down the steps to solve a mathematical problem.

Discussion

Before conducting the test, researchers conducted learning in class VIIIA based on the learning trajectory or HLT which had been designed using the PMR approach consisting of 4 problems, namely the first and second problems in the first meeting learning while the third and fourth problems in the second meeting learning.

In the learning process the researcher accompanies students in group discussions. When there are students having difficulty in solving a given problem, the researcher gives a support in the form of questions that provoke students to find answers to the questions given. Students pay attention and try to find answers to the support given by the researcher.

At the third meeting the researchers gave written tests. The question given was “Aldi bought 4 books and 4 pencils at a price of Rp. 20,000. Ida bought 3 books and 2 pencils for Rp. 13,000. If Mira wants to buy 2 books and 1 pencil, how much does Mira have to pay?”

1. Mathematical representation of RPH (S1)
Analysis of student answers according to indicators:

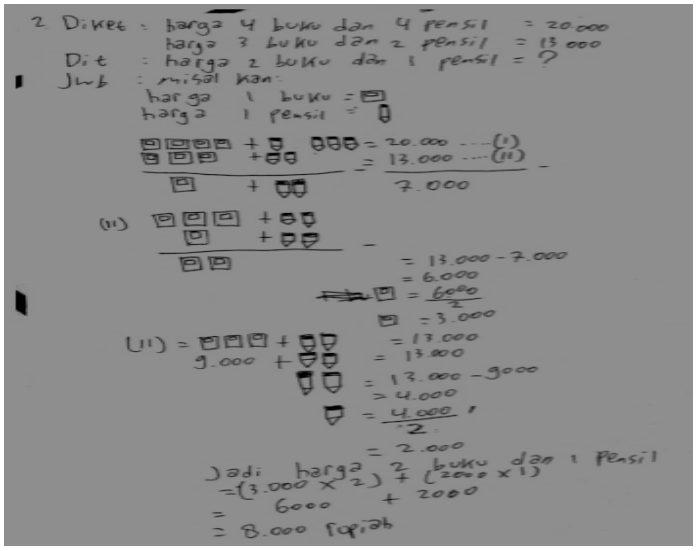


Figure 1. RPH answers (students 1 or S1) or mathematical representations of RPH

Excerpt of interview:

P (teacher) : "What is known about the problem?"
S1 (student 1) : "The price of 4 books and 4 pencils is equal to 20,000; and the price of 3 books and 2 pencils is 13,000"
P : "What was asked about the question?"
S1 : "Price of 2 books and 1 pencil"
P : "Why do you say a picture of a book and a pencil drawing, then write 4 picture books plus 4 pencil drawings equal to 20,000 and a picture of a book plus 2 pencil drawings equal to 13,000?"
S1 : "So it's easy to finish Mother."
P : "Why do you subtract pressure 1 with equation 2 then subtract equations 2 and 3?"
S1 : "To remove a pencil image and get a price of 1 book"
P : "Why is Equation (ii) three pictures of books replaced with 9,000?"
S1 : "There is a price of one book 50,000 mothers, so three books are 9,000 (while showing"
P : "Can you use equation 1 or 3 to replace the price of the book?"
S1 : "yes, it can be done ..."
P : "What is the purpose of replacing 3 books with 9,000?"
S1 : "To get the value of one pencil"
P : "Why is 3,000 times 2 plus 2,000 times 1?"
S1 : "Because the one asked for is one book and one pencil."
P : "Is the price of one book and pencil correct?"
S1 : "It's already Mother ..."
P : "How do you know?"
S1 : "The prices of books and pencils are included in this equation and the results are the same (while showing equations 1 and 2)"
P : "What are your conclusions from the answers you have received?"
S1 : "so the price of 2 books and 1 pencil is 8,000 rupiah"
P : "Try to re-read the question, is it asked for the price of 2 books and 1 pencil?"
S1 : "Hummm ... who was asked how much money Mira had to pay?"
P : "What do you mean by your conclusion?"
S1 : "So Mira has to pay eight thousand rupiah"

Based on the results of interviews and seeing the results of written tests it can be concluded that RPH meets all indicators where:

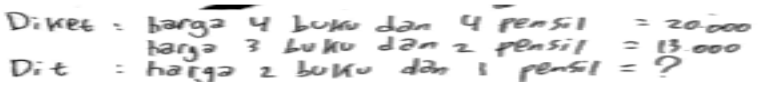
a) RPH presents data or information from a problem to image representation,
RPH presents problems using images that are book images ( ) and pencil drawings ( ) then RPH meets indicator one.

b) Resolve problems that involve mathematically.
RPH solve problems involving mathematical experiments such as equations or

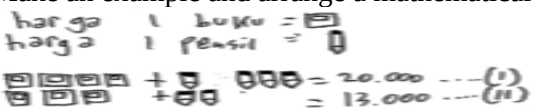
And mathematical symbols such as addition operations (+), subtraction (-), multiplication (x) and equals (=).

c) Writing down steps to solve mathematical problems.
RPH resolves problems using steps namely

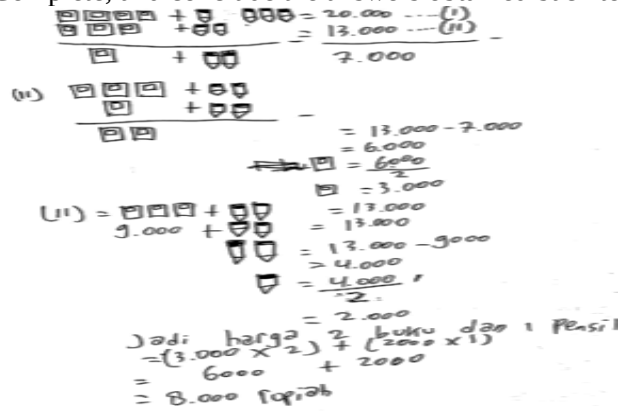
- Write down what is known and asked from the question.



- Make an example and arrange a mathematical model.



- Complete, and conclude the answers obtained back to the context of the question



1. Mathematical representation of ARC (S2)

Analysis of student answers according to indicators:

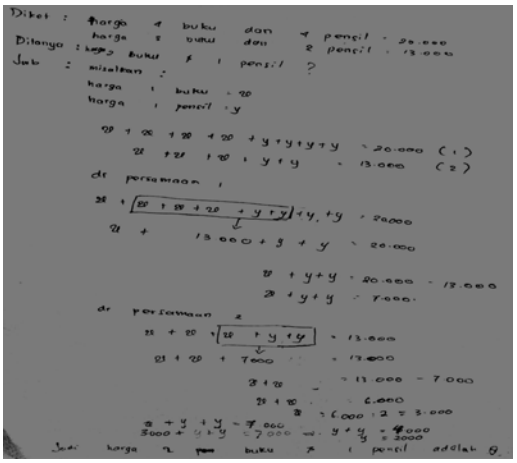


Figure 2. ARC answers (students 2 or S2) or mathematical representations of ARC

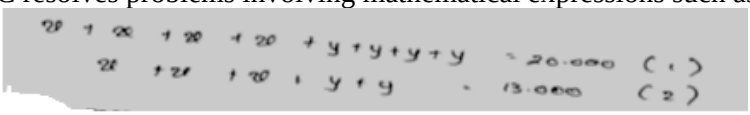
Excerpt of interview:

P (teacher) : "What is known about the question?"
S1 (student 1): "The price of 4 books and 4 pencils is 20,000; and the price of 3 books and 2 pencils is 13,000."
P : "What was asked about the question?"
S2 : "Price of 2 books and 1 pencil"
P : "Why do you suppose *x* and *y*, then write *x* plus 4 times plus *y* 3 times equal to 20,000; *x* added 3 times plus *y* twice as much as 13,000?"
S2 : "So it's easy to finish Mother."
P : "Why is this (i) in this box and writing 13,000 below it? (while showing equation 1)"
S2 : "Because in equation 2 the price of this (while showing) is equal to 13,000, so I change my mother"
P : "Why does *x* plus *x* plus *y* equal to 8,000, immediately stop working and conclude?"
S2 : "Because the one asking for the price was 2 books and one pencil, and this has answered the question about Mother."
P : "Are you sure the value of $x + x + y$ is 8,000?"
S2 : "Already Ma'am ..."
P : "How do you know?"
S2 : "I see one by one from the steps I use, nothing I miscalculated ... (while pointing out)"
P : "Why do you suppose *x* and *y*, then write *x* plus 4 times plus *y* 3 times equal to 20,000; *x* added 3 times plus *y* twice as much as 13,000?"
S2 : "So it's easy to finish Mother."
P : "Why is Equation (i) in this box and writing 13,000 below it? (while showing equation 1)"
S2 : "Because in equation 2 the price of this (while showing) is equal to 13,000, so I change my mother"
P : "Why does *x* plus *x* plus *y* equal to 8,000, immediately stop working and conclude?"
S2 : "Because the one asking for the price was 2 books and one pencil, and this has answered the question about Mother."
P : "Are you sure the value of $x + x + y$ is 8,000?"
S2 : "Already Ma'am ..."
P : "How do you know?"
S2 : "I see one by one from the steps I use, nothing I miscalculated ... (while pointing out)"
P : "What are your conclusions from the answers you have received?"
S2 : "So the price of 2 books and 1 pencil is 8,000 rupiah"
P : "Try to re-read the question, is it asked for the price of 2 books and 1 pencil?"
S2 : "Who was asked how much money Mira had to pay?"
P : "What do you mean by your conclusion?"
S2 : "So Mira has to pay eight thousand rupiahs for"

Based on the results of interviews and seeing the results of written tests it can be concluded that ARC meets all indicators where:

a. ARC presents data or information from a problem to symbol representation.
   The ARC answer above resolves the problem using symbol representation, where the RPH presents a problem using symbols namely the symbol *x* and symbol *y*.
b. ARC resolves problems that involve mathematically.

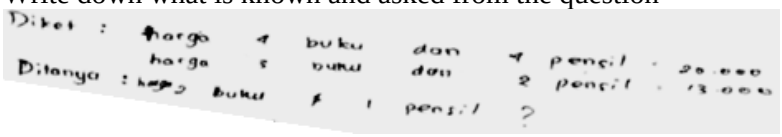
ARC resolves problems involving mathematical expressions such as equations or



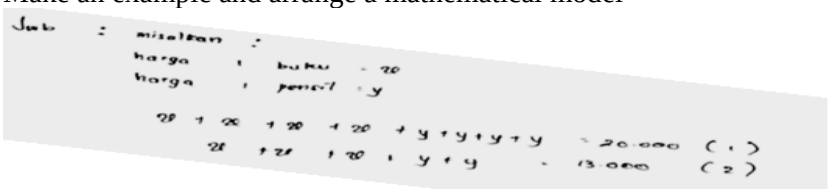
And mathematical symbols such as addition operations (+), subtraction (-), division (:) and equals (=).

c. ARC writes steps to solve mathematical problems.
ARC resolves problems using steps namely:

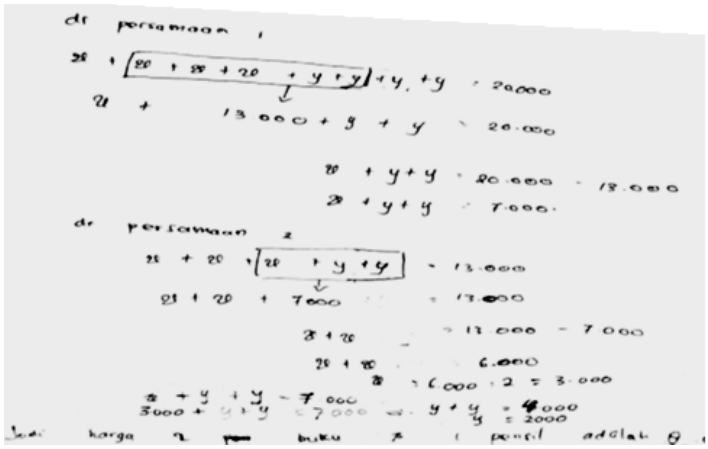
- Write down what is known and asked from the question



- Make an example and arrange a mathematical model



- Complete, and conclude the answers obtained back to the context of SOA



Conclusion

Based on the results of research and discussion of the forms of representation used by students in solving LESTV problems, the conclusion is that students who use image representation and symbol representations in solving everyday problems related to LESTV fulfill the three mathematical representation indicators, namely presenting data or information from problems to image representation, solving problems involves mathematics, and writing steps to solve mathematical problems.

REFERENCES

Cai, J., Lane, S., & Jakabcsin, M. S. (1996). The role of open-ended tasks and holistic scoring rubrics: assessing student's mathematical reasoning and communication. In P. C. Elliot and M. J. Kenney (Eds.), *Yearbook Communication in Mathematics K-12 and Beyond*. Reston, VA: The National Council of Teachers of Mathematics.

Goldin, G. A., & Kaput, J. J. (2013). A Joint Perspective on the Idea of Representation in Learning and Doing Mathematics. In L. P. Steffe, P. Nesher, P. Cobb, B. Sriraman, & B. Greer (Eds.), *Theories of Mathematical Learning* (pp. 409-442). New York: Routledge.

Helingo, D. D. Z., Mamin, S., & Masriyah, M. (2018). Translation process of mathematics

representation: From graphics to symbols and vice versa. *Journal of Physics: Conference Series, 1188*, 012055.

Minarni, A., Napitupulu, E., & Husein, R. (2016). Mathematical understanding and representation ability of public junior high school in North Sumatra. *Journal on Mathematics Education, 7*(1), 43-56.

Muhtarom, M., Nizaruddin, N., Nursyahidah, F., & Happy, N. (2019). The effectiveness of realistic mathematics education to improve students' multi-representation ability. *Infinity Journal, 8*(1), 21-30.

NCTM. (2000). *Principles and standards for school mathematics.* Reston, VA: NCTM.

Nie, B. D., & Cao, B. Y. (2019). Three mathematical representations and an improved ADI method for hyperbolic heat conduction. *International Journal of Heat and Mass Transfer, 135*, 974-984.

Rahmah, F., Subanji, & Irawati, S. (2019). Mathematical representation analysis of students in solving mathematics problems. *Journal of Physics: Conference Series, 1200*, 012011.

Sedig, K., & Sumner, M. (2006). Characterizing interaction with visual mathematical representations. *International Journal of Computers for Mathematical Learning, 11*(1), 1-55.

Sulastri, Marwan, & Duskri, M. (2017). Kemampuan representasi matematis siswa SMP melalui pendekatan pendidikan matematika realistik. *Beta: Jurnal Tadris Matematika, 10*(1), 51-69.